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(54) [Title of the Invention] Filter device

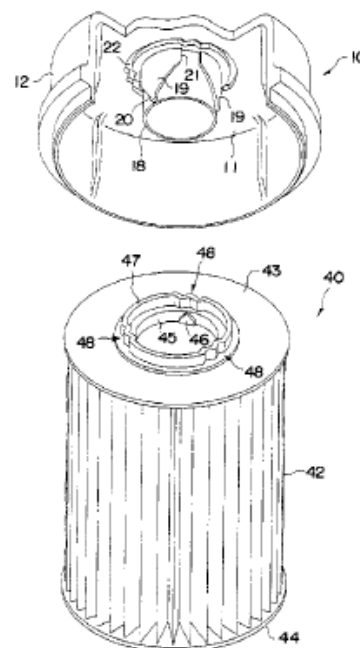
(57) [Abstract]

[Problem] To provide a filter device having a structure in which a filter element can be easily assembled into a filter case, and a sealing member provided between the filter element and the filter case can be prevented from being damaged.

[Means for Solving] One or more locking protrusions 46 are provided on the inner periphery of the opening 45 formed in the filter element 40 so as to protrude toward the center of the opening 45, and at the same time, on the outer periphery of the pipe portion 18 provided in the upper case half 10,

a plurality of pleated portions 19 extending downward are provided. After attaching the filter element 40 to the upper case half 10 so that the locking protrusion 46 is located in the depressions 21 formed between the two adjacent pleated portions 19, the filter element 40 is assembled into the filter case 5 by screwing and coupling the lower case half 30 to the upper case half 10.

[Representative Drawing] FIG. 1



[Scope of Patent Claims]

[Claim 1]

A filter device characterized by comprising: a filter case comprising an inlet and an outlet of fluid and having a filter element retention space therein;

a filter element installed to extend in the vertical direction within the filter element holding space formed inside the filter case with an upper plate and a lower plate provided above and below a cylindrical filter medium portion extending vertically,

wherein the filter case comprises an upper case half that opens downward and a lower case half that opens upward, and both case halves are connected by screwing a male thread formed on the outer periphery of one into a female thread formed on the outer periphery of the other,

wherein the upper case half is provided with a cylindrical pipe portion extending downward and connected to the fluid inflow channel or the fluid outflow channel,

wherein, in a filter device configured such that the pipe portion is inserted from above into an opening formed in the upper plate of the filter element with the filter element installed in the filter element holding space,

one or more locking protrusions protruding toward the center of the opening are provided on the inner circumference of the opening formed in the filter element, and at the same time a plurality of pleated portions extending downward are provided on the outer periphery of the pipe portion provided in the upper case half,

wherein the configuration is such that after attaching the filter element to the upper case half so that the locking protrusion is located in depressions formed between the two adjacent pleated portions, the filter element is assembled into the filter case by screwing the lower case half into the upper case half to connect both case halves.

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[Claim 2]

The filter device according to Claim 1, characterized in that the left and right side surfaces of each of the pleated portions provided on the upper case half are formed in a tapered shape that narrows downward.

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[Claim 3]

The filter device according to Claim 1 or 2, characterized in that the lower end of each of the pleated portions provided on the upper case half has a downwardly pointed shape, and the upper end of the locking protrusion provided on the filter element has an upwardly pointed shape.

[Claim 4]

A filter device according to any of Claims 1 to 3, characterized in that among the plurality of pleated portions provided in the upper case half, a lower end of one of the pleated portions extends downwardly more than a lower end of the other pleated portions.

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[Claim 5]

The filter device according to any one of Claims 1 to 4, characterized in that a ring-shaped sealing member having a W-shape at three locations is provided on the upper surface side of the upper plate, surrounding the opening and protruding upward, and grooves into which the sealing member fits when the two case halves are combined is formed in the upper case half at a position surrounding the pipe portion.

[Claim 6]

The filter device according to any one of Claims 1 to 5, characterized in that the filter element installed in the filter element holding space is a protrusion provided on the bottom surface of the lower plate so as to protrude downward and is brought into contact with a filter element mounting part formed on the bottom of the lower case half.

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[Detailed Description of the Invention]

(0001)

[Technical Field to Which the Invention Belongs]

The present invention relates to a filter device in which a cylindrical filter element is held in a filter case provided with a fluid inlet and an outlet, and in particular relates to a filter device having a configuration wherein the filter case consists of two case halves, with a cylindrical filter element attached to one case half, in which the filter element is assembled into the filter case by screwing the other case half into this one case half and joining both case halves.

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(0002)

[Prior Art]

The filter device has a replaceable filter element held inside the filter case. After the fluid flows in through the fluid inflow route formed in the filter case and passes through the filter element, it flows out through the fluid outflow route also formed in the filter case, so that dirt, dust, etc. contained in the fluid can be removed.

[0003]

In some such filter devices, the filter case consists of two case halves, and have a configuration in which the filter element is assembled into the filter case by attaching the cylindrical filter element to one case half and then screwing the other case half into this one case half to join both case halves. (For example, see Patent Literature 1 below). In a filter device with such a configuration, a pipe extending from one case half and connected to the fluid outflow route is inserted into an opening provided at one end of the filter element, and the fluid that has been filtered in the filter element flows out of the filter case from this pipe portion.

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[0004]

[Patent Literature 1]

Registered Utility Model Number 3073564

[0005]

[Problem to be Solved by the Invention]

However, in a filter device having such a configuration, when the other case half is screwed into one case half with the filter element attached, the lower part of the filter element contacts the other case half, causing it (the filter element) to be twisted relative to the upper case half, so while the two case halves are being joined (screwed together), and in some cases, the filter element is in an unstable position (for example, wobbles), making it impossible to smoothly connect the two case halves. Furthermore, if a sealing member is attached around the opening formed in the filter element (the opening through which the tube is inserted), and the tube is configured to be inserted through the sealing member, while screwing the other case half into one case half, there are cases where the sealing member rotates relative to the pipe portion, which may cause damage to the sealing member, or the sealing function deteriorates due to the enlargement of the inner diameter.

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[0006]

The present invention was made in view of these problems, and its objective is to provide a filter device having a structure in which a filter element can be easily assembled into a filter case, and a sealing member provided between the filter element and the filter case can be prevented from being damaged.

[0007]

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[Means for Solving the Problem]

To achieve this objective, the filter device according to the present invention comprises a filter case that includes a fluid inflow route (for example, the fuel inflow route 15 in the embodiment) and an outflow route (for example, the fuel outflow route 17 in the embodiment) and has a filter element holding space therein, an upper plate and a lower plate provided above and below a cylindrical filter medium portion (for example, the portion consisting of the cylindrical portion 41 and the filter medium 42 in the embodiment) extending vertically, and the filter element holding space formed inside the filter case. and a filter element installed to extend in the vertical direction, wherein the filter case consists of an upper case half that opens downward and a lower case half that opens upward, wherein both case halves are connected by screwing a male thread formed on the outer periphery of one into a female thread formed on the outer periphery of the other, the upper case half is provided with a cylindrical pipe extending downward and connected to a fluid inflow route or a fluid outflow route, wherein, in a filter device configured such that a pipe portion is inserted from above into an opening formed in an upper plate of the filter element with the filter element installed in the filter element holding space, one or more locking protrusions protruding toward the center of the opening are provided on the inner circumference of the opening formed in the filter element, and at the same time a plurality of pleated portions extending downward are provided on the outer periphery of the tube provided in the upper case half, and after installing the filter element in the upper case half so that the locking protrusion is located in the depressions formed between two adjacent pleated portions, the filter element is assembled into the filter case by screwing the lower case half into the upper case half to connect both case halves.

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[0008]

In the filter device according to the present invention, in order to assemble the filter element to the filter case, first, the pipe portion of the upper case half is inserted through the opening provided in the upper plate of the filter element, and the filter element is attached to the upper case half. However, at this time, the locking protrusion formed inside the opening is positioned within the depressions between the pleated portions provided on the outer periphery of the tube. Therefore, when the lower case half is screwed into the upper case half later, even if the lower case half comes into contact with the filter element, the filter element will not rotate relative to the upper case half, and the filter element will not wobble and become unstable. Therefore, it is possible to smoothly combine the two case halves, making it very easy to assemble the filter element into the filter case. Also, even if a sealing member is attached around the opening of the filter element, the filter element will not rotate relative to the upper case half while the lower case half is screwed into the upper case half. Therefore, there is no possibility that the sealing member will be damaged due to relative rotation with the pipe portion, or that the sealing function will be deteriorated due to an increase in the inner diameter.

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[0009]

In addition, in the filter device according to the present invention, it is preferable that the left and right side portions of each of the pleated portions provided in the upper case half are formed in a tapered shape that narrows downward. If the configuration is like this, when attaching the filter element to the upper case half, the locking protrusion on the filter element side is guided by the side surface of the pleated portion so that it smoothly enters the depressions formed between two adjacent pleated portions. Therefore, attachment of the filter element to the upper case half becomes very easy.

[0010]

Further, in the filter device according to the present invention, it is preferable that the lower end portion of each pleated portion provided in the upper case half has a shape that is pointed downward, and at the same time, the upper end of the locking protrusion provided on the filter element has an upwardly pointed shape. If the configuration is like this, when trying to attach the filter element to the upper case half, even if the tip (upper end) of the locking protrusion on the filter element side is located exactly opposite the tip (lower end) of the pleated portion, it will shift to the left or right when the locking protrusion comes into contact with the pleated portion. Therefore, the locking protrusion and the pleated portion do not press against each other while remaining in contact with each other, and the filter element can be more smoothly attached to the upper case half. This has a greater effect when, among the multiple pleated portions provided on the upper case half, the lower end of one pleated portion is configured to protrude and extend further downward than the lower end of the other pleated portion.

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[0011]

In addition, in the filter device according to the present invention, it is preferable that a ring-shaped sealing member having a W-shape at three locations is provided on the upper surface side of the upper plate, surrounding the opening and protruding upward, and grooves into which the sealing member fits when the two case halves are combined is formed in the upper case half at a position surrounding the pipe portion. In such a configuration, the friction generated in the sealing member when the filter element and the upper case half are attached (friction caused by rubbing against the upper case half) is only generated when the upper case half and lower case half are finished joining, and abrasion of the sealing member can be reduced compared to a conventional filter device in which the sealing member is attached to the inner circumferential side of the opening and the pipe portion of the upper case half is inserted therethrough. Furthermore, when the upper case half and the lower case half are connected, the sealing member fits into the grooves, thereby fixing the attitude of the filter element with respect to the upper case half. Therefore, subsequent installation (screwing) of the lower case half becomes very easy.

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[0012]

Further, in the filter device according to the present invention, it is preferable that the filter element installed in the filter element holding space is a protrusion provided on the bottom surface of the lower plate so as to protrude downward (for example, the ring-shaped protrusion 49 in the embodiment) is brought into contact with a filter element mounting part formed on the bottom of the lower case half. If the configuration is like this, by changing the position of the protrusion (for example, if the protrusion is ring-shaped, the radius measured from the central axis of the filter element) for each filter element production stage (for example, for each filter element manufacturing lot), the contact point of this protrusion against the filter element mounting part can be changed, and even if the filter element is replaced many times, the locations where the filter element mounting part is worn out are dispersed, preventing wear from concentrating on localized areas. Therefore, the life of the filter case can be prevented from decreasing. In addition, the rattle between the filter case and filter element that occurs due to this wear can be reduced. Therefore, the mounting position of the filter element within the filter case can always be maintained accurately.

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[0013]

[Embodiments of the Invention]

Preferred embodiments of the present invention will be described with reference to the drawings below. FIG. 2 is a perspective view of a filter device 1 as a fuel filter according to an embodiment of the present invention, viewed diagonally from above. FIG. 3 is a cross-sectional view of the filter device 1 taken along arrows III-III in FIG. 2. As shown in both of these figures, this filter device 1 is configured with an upper case half 10 having a horizontal ceiling part 11 and a side wall part 12 and opening downward, a filter case 5 consisting of a lower case half 30 having a bottom surface portion 31 and a side wall portion 32 and opening upward and a cylindrical filter element 40 extending vertically is installed in the filter element holding space 7 formed in the filter case 5 and held by both case halves 10 and 30. FIGS. 4(A), (B), and (C) respectively show a side view, a top view, and a bottom view of the filter element 40 alone. FIG. 1 shows both a perspective view of the upper case half 10 seen from below and a perspective view of the filter element 40 seen diagonally from above.

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[0014]

As shown in FIGS. 2 and 3, the upper case half 10 and the lower case half 30 are removably connected by screwing together the female threads 13 formed on the outer circumference of the lower end of the side wall portion 12 of the upper case half body 10, and the male threads 33 formed on the upper outer periphery of the side wall 32 of the lower case half 30. A plurality of ribs 35 are provided on the upper surface side of the bottom portion 31 of the lower case half body 30, and are arranged radially and extend vertically, and the upper surfaces of the plurality of ribs 35 are formed horizontally and constitute a filter element mounting part 36. Here, the filter element mounting part 36 does not necessarily have to be formed on the upper surface of a radially formed portion like the rib 35, and it may be formed on the upper surface of a simple disk-shaped portion.

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[0015]

As shown in FIG. 3, a cavity 14 is provided at the upper left side of the upper case half 10, and a fuel inflow route 15 communicating with the cavity 14 is provided in the ceiling 11 and extends in the left-right direction. Further, a cylindrical pipe portion 18 is formed in the center of the ceiling portion 11 of the upper case 10, and projects downward from the lower surface side and extends into the filter element holding space 7, and the internal space communicates with a fuel outflow route 17 provided in the center of the ceiling part 11 and extending vertically.

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[0016]

As shown in FIG. 1, the outer circumferential portion of the pipe portion 18 provided in the upper case half 10 is provided with three pleated portions 19 extending downward (in FIG. 1, three pleated portions 19 (only two of the three are visible)). FIG. 5 shows a developed view of the pipe portion 18 provided in the upper case half 10. As shown in this figure, the left and right side surfaces 19a of each of the pleated portions 19 may extend parallel to the vertical direction, but as shown in this figure, they are preferably formed in a tapered shape that narrows downward. In addition, it is preferable that the lower end portion of each pleated portion 19 has a downwardly pointed shape. Furthermore, it is preferable that the lower end of one of the pleated portions 19 protrudes and extends further downward than the lower ends of the other pleated portions 19 (see protrusion 20 shown in FIG. 5).

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[0017]

As shown in FIGS. 2 and 3, a plate-shaped filter device fixing bracket 23 is provided on the upper part of the upper case half 10 and extends upward, and bolt mounting holes 24 are formed at both ends thereof. The upper case half 10 is fixed to the filter device fixing part FB (For example, if this filter device 1 is an engine oil filter, it is a part of the engine case) with bolts B and nuts N through these bolt attachment holes 24. Further, as shown in FIG. 2, a fuel inflow pipe IP is connected to the fuel inflow route 15 of the upper case half 10, and a fuel outflow pipe OP is connected to the fuel outflow route 17.

[0018]

As shown in FIGS. 1, 3 and 4, the filter element 40 has a structure in which a filter medium 42 bent in a bellows shape is attached around a thin-walled cylindrical inner cylinder 41 configured in a lattice shape, and a disc-shaped upper plate 43 is attached to its upper end, and a disc-shaped lower plate 44 is attached to its lower end. A circular opening 45 is provided in the center of the upper plate 43, and when the filter element 40 is attached to the upper case half 10 (described later), the pipe portion 18 of the upper case half 10 is inserted through the opening 45. Furthermore, as shown in FIGS. 3 and 4, a ring-shaped protrusion 49 is provided on the bottom surface of the lower plate 44 and projects downward.

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[0019]

As shown in FIGS. 1 and 4, three locking protrusions 46 are provided on the inner periphery of the opening 45 of the upper plate 43, protruding toward the center of the opening 45. As will be described later, when the filter element 40 is attached to the upper case half 10 so that the pipe portion 18 of the upper case half 10 is inserted into the opening 45 of the filter element 40, these three locking protrusions 46 are configured to fit into depressions 21 formed between adjacent ones of the three pleated portions 19 provided on the upper case 10 side (see the locking protrusion 46 shown in broken lines in FIG. 5). Note that the tips (upper ends) of these three locking protrusions 46 preferably have an upwardly pointed shape, as shown in FIG. 1.

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[0020]

In addition, as shown in FIGS. 1, 3 and 4, a ring-shaped sealing member 47 is provided on the upper surface side of the upper plate 43 at a position surrounding the opening 45 so as to protrude upward. This sealing member 47 is made of an elastic material such as rubber, and its outer shape has three W-shaped portions 48 formed in a "W" shape at 120 degree intervals with respect to the center of the sealing member 47 as a reference. On the other hand, as shown in FIGS. 1 and 3, grooves 22 having a shape that is an inversion of the top surface shape of the sealing member 47 are provided on the lower surface side of the ceiling portion 11 in the upper case half 10 (Naturally, the sealing member 47 has inverted portions corresponding to the three W-shaped portions described above. See FIG. 1.), and as will be described later, when the filter element 40 is attached to the upper case half 10, the sealing member 47 on the filter element 40 side is fitted into the grooves 22 on the upper case half 10 side.

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[0021]

To assemble the filter element 40 into the filter case 5, first, the filter element 40 is pushed upward so that the pipe portion 18 (and the three pleated portions 19) of the upper case half 10 passes through the opening 45 of the upper plate 43 in the filter element 40 from above. As a result, the three locking protrusions 46 provided on the upper plate 43 are guided by the side surfaces 19a of the three pleated portions 19 provided on the upper case half 10, and move upward (At this time, the filter element 40 will rotate slightly in the twisting direction), and they fit into depressions 21 formed between two adjacent pleated portions 19, respectively. FIG. 6 shows an example of the route followed by the locking protrusion 46 that abuts the side surface 19a of the pleated portion 19 when the filter element 40 is pushed up toward the upper case half 10. The locking protrusion 46 advances in the direction shown by the arrow in the figure and fits into the depressions 21 formed between the two adjacent pleated portions 19.

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[0022]

In addition, in this state in which each of the locking protrusions 46 of the filter element 40 is inserted into the depressions 21 formed between the adjacent pleated portions 19 of the upper case half 10, a sealing member 47 provided on the upper plate 43 of the filter element 40 fits into the grooves 22 of the upper case half 10. At this time, the three W-shaped portions 48 provided on the sealing member 47 fit into the portions of the grooves 22 that have the opposite shape. As a result, the filter element 40 is temporarily fixed to the upper case half 10.

[0023]

Here, as mentioned above, each of the three pleated portions 19 provided on the upper case half 10 has a downwardly pointed lower end. In addition, if the upper end of each locking protrusion 46 provided on the filter element 40 has an upwardly pointed shape, when trying to attach the filter element 40 to the upper case half 10, even if the tip (upper end) of the locking protrusion 46 on the filter element 40 side is located exactly opposite the tip (lower end) of the pleated portion 19, when the locking protrusion 46 comes into contact with pleated portion 19, it will shift to the left or right. Therefore, the locking protrusions 46 and pleated portions 19 do not press against each other while remaining in contact with each other, and the filter element 40 is smoothly attached to the upper case half 10. Furthermore, since the present filter device 1 has a configuration in which the lower end of one of the pleated portions 19 extends downwardly more than the lower end of the other pleated portions 19, the effect is very large.

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[0024]

After the filter element 40 is temporarily fixed to the upper case half 10, the lower case half 30 is then attached to the upper case half 10. This is done by screwing the lower case half 30 into the upper case half 10 so that the male threads 33 provided on the side wall portion 32 of the lower case half 30 and the female threads 13 provided on the side wall portion 12 of the upper case half 10 are screwed together. Here, the ring-shaped protrusion 49, in which a screw is installed at the bottom of the lower case half 30 immediately before the screwing of the lower case half 30 to the upper case half 10 is completed, contacts the filter element mounting part 36 provided at the bottom of the lower case half 30 from below. When the lower case half 30 is further screwed into the upper case half 10, the filter element 40 is pressed against the upper case half 10 by the lower case 30, and when the upper and lower case halves 10 and 30 are completely connected, the filter element 40 is held in the filter element holding space 7 while being held between the upper and lower case halves 10 and 30. Also, in this state, the sealing member 47 provided on the upper plate 43 of the filter element 40 is pressed upward within the grooves 22 formed in the upper case half 10. Therefore, the sealing member 47 firmly seals between the upper case half 10 and the filter element 40.

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(0025)

It should be noted that when the lower case half 30 is screwed into the upper case half 10, the filter element 40 is fixed to the upper case half 10. Therefore, just before the screwing of the lower case half 30 to the upper case half 10 is completed, from after the filter element mounting part 36 of the lower case half 30 comes into contact with the ring-shaped protrusion 49 of the filter element 40 until the screwing of the lower case half 30 into the upper case half 10 is completed, the lower case half 30 and the filter element 40 rotate relative to each other, and friction occurs at their contact portions. However, as mentioned above, the lower case half 30 and the filter element 40 come into contact with each other through a filter element mounting portion 36 provided on the lower case half 30 and a ring-shaped protrusion 49 provided on the lower plate 44 of the filter element 40. Therefore, a worn portion (a worn portion caused by rubbing against the ring-shaped protrusion 49) in the filter element mounting part 36 is not the entire filter element mounting portion 36 but only a portion that contacts the ring-shaped protrusion 49.

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(0026)

The filter element 40 is a consumable item, and when the filter medium 42 becomes clogged or a predetermined period of time has elapsed, it is necessary to remove the lower case half 30 from the upper case half 10 and replace it. For this reason, the filter element mounting part 36 is repeatedly worn due to contact with the filter element 40. However, as mentioned above, the lower case half 30 and the filter element 40 are arranged such that the filter element mounting part 36 provided on the lower case half 30 and the ring-shaped protrusion 49 provided on the lower plate 44 of the filter element 40 are in contact with each other. Therefore, for each production stage of the filter element 40 (for example, for each manufacturing lot of the filter element 40), if the radius R of the ring-shaped protrusion 49 (the distance from the center O of the ring-shaped protrusion 49 to the center of the ring width of the ring-shaped protrusion 49 in FIG. 4(C)) is varied in several different ranges, the location of the ring-shaped protrusion 49 on the filter element mounting portion 36 can be changed, and wear can be prevented from concentrating on a localized location.

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[0027]

FIG. 7 is a bottom view of the filter element 40 having three types of ring-shaped protrusions 49 that differ depending on the manufacturing lot. FIG. 7(A) shows a filter element (represented by reference numeral 40a) according to the first production lot in which the radius R of the ring-shaped protrusion 49 is R1. FIG. 7(B) shows a filter element (represented by reference numeral 40b) according to a second production lot in which the radius R of the ring-shaped protrusion 49 is R2. FIG. 7C shows a filter element (represented by reference numeral 40c) according to the third production lot in which the radius R of the ring-shaped protrusion 49 is R3 (where $R1 > R2 > R3$). With this configuration, even if the filter element 40 is replaced many times, the locations where the filter element mounting part 36 is worn out are dispersed, and wear is prevented from concentrating on localized locations. be done. Therefore, the life of the filter case 5 can be prevented from decreasing. In addition, the rattle between the filter case 5 and filter element 40 that occurs due to this wear can be reduced. Therefore, the mounting position of the filter element 40 within the filter case 5 can always be maintained accurately.

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[0028]

In the filter device 1 in which the filter element 40 is assembled in the filter case 5 in this way, the fuel that has flowed into the filter case 5 from the fuel inflow pipe IP reaches the filter element holding space 7 in the filter case 5 from the cavity 14 provided in the upper case half 10, and it passes through the filter medium 42 of the filter element 40 and enters the inner cylinder 41. Dirt, dust, fine iron chips, etc. contained in the fuel are filtered when passing through this filter medium 42. Then, the filtered fuel that has entered the inner cylinder 41 passes through the fuel outflow route 17 from the pipe portion 18 formed in the upper case half 10, and the fuel flows out of the filter case 5 through the fuel outflow pipe OP connected thereto.

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[0029]

By the way, as mentioned above, in this filter device 1, when attaching the filter element 40 to the upper case half 10 so that the pipe portion 18 of the upper case half 10 passes through the opening 45 provided in the upper plate 43 of the filter element 40, a locking protrusion 46 formed inside the opening 45 is positioned in a depressions 21 between adjacent three pleated portions 19 formed on the outer periphery of the pipe portion 18. Therefore, even if the lower case half 30 comes into contact with the lower plate 44 of the filter element 40 when the lower case half 30 is screwed into the upper case half 10 later, the filter element 40 does not rotate relative to the upper case half 10, and the filter element does not wobble into an unstable position. Therefore, it is possible to smoothly combine the two case halves 10, 30, making it very easy to assemble the filter element 40 into the filter case 5.

[0030]

In addition, with such a configuration, the sealing member 47 is not provided on the upper surface side of the upper plate 43 of the filter element 40 as in the present filter device 1, and even in the case of a configuration in which a sealing member is attached around the opening 45 of the filter element 40, while the lower case half 30 is screwed into the upper case half 10, the filter element 40 does not rotate relative to the upper case half 10. Therefore, the sealing member will not be damaged due to relative rotation with the pipe portion 18, and the sealing function will not deteriorate due to an increase in the inner diameter.

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[0031]

Furthermore, in the present filter device 1, as described above, the left and right side surfaces 19a of each of the pleated portions 19 provided on the upper case half 10 are formed in a tapered shape that narrows downward. Therefore, when attaching the filter element 40 to the upper case half 10, the locking protrusion 46 on the side of the filter element 40 is guided by the side surface portion 19a of the pleated portion 19 and smoothly enters between two adjacent pleated portions 19. Therefore, attachment of the filter element 40 to the upper case half 10 becomes very easy.

[0032]

In addition, in this filter device 1, the friction generated in the sealing member 47 when the filter element 40 and the upper case half 10 are attached (friction caused by rubbing against the upper case half 10) is only generated when the upper case half 10 and lower case half 30 are finished joining, and abrasion of the sealing member can be reduced compared to a conventional filter device in which the sealing member is attached to the inner circumferential side of the opening 45 and the pipe portion 18 of the upper case half 10 is inserted therethrough. Furthermore, when the upper case half 10 and the lower case half 30 are connected, the sealing member fits into the grooves, thereby fixing the attitude of the filter element with respect to the upper case half 10. Therefore, subsequent installation (screwing into the upper case half 10) of the lower case half 30 becomes very easy.

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[0033]

While embodiments of filter devices according to the present invention have been described, the scope of the present invention is not limited to those described above. For example, in the embodiment described above, there are three locking protrusions 46 provided on the filter element 40 side and three pleated portions 19 provided on the upper case half 10 side, but this is only an example. That is, the locking protrusions 46 may be one or more, and the pleated portions 19 may be formed in the same number as or greater than the number of the locking protrusions 46. Moreover, as shown in the above embodiment, the number of locking protrusions 46 does not have to correspond to the number of depressions 21 formed between two adjacent pleated portions 19, and may be less than the number of depressions 21.

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[0034]

Further, in the above embodiment, the female threads 13 were provided on the side wall 12 of the upper case half 10, and the male threads 33 were provided on the side wall 32 of the lower case half 30. However, these may be reversed, and the side wall portion 12 of the upper case half 10 may be provided with male threads, and the side wall portion 32 of the lower case half 30 may be provided with female threads.

(0035)

Furthermore, the protrusion that is provided on the bottom surface of the lower plate 44 so as to protrude downward and comes into contact with the filter element mounting portion 36 of the lower case half 30 is not formed in a ring shape in the above-described embodiment. However, this is because the filter element mounting part 36 is formed on the upper surface of the ribs 35 provided radially at the bottom of the lower case half 30, and if a disc-shaped part is formed instead of a rib, and the top surface of the disc-shaped part serves as the filter element mounting part, the protrusion provided on the lower plate 44 does not necessarily have to be ring-shaped, and may be a simple protrusion. However, in order for the filter element 40 to be stable within the filter element holding space 7, three or more are required. In addition, even in this case, by changing the positions of these protrusions at each filter element production stage (for example, each filter element production lot), as in the above-described embodiment, the location where the protrusion touches the filter element mounting part can be changed.

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(0036)

In addition, in the filter device 1 in the above embodiment, the pipe portion of the upper case half was used as a passage communicating with the fuel outflow route. However, the present invention can also be applied to a filter device in which the pipe portion is used in communication with the fuel inflow route. In addition, in the above embodiment, the filter device according to the present invention is described as a fuel filter in which the fluid to be filtered is fuel. However, the filter device according to the present invention can also be used as an oil filter in which the fluid to be filtered is oil, or an air filter in which the fluid to be filtered is air.

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[0037]

(Effect of the Invention)

As explained above, in the filter device according to the present invention, in order to assemble the filter element to the filter case, first, the pipe portion of the upper case half is inserted through the opening provided in the upper plate of the filter element, and the filter element is attached to the upper case half. However, at this time, the locking protrusion formed inside the opening is positioned within the depressions between the pleated portions provided on the outer periphery of the tube. Therefore, when the lower case half is screwed into the upper case half later, even if the lower case half comes into contact with the filter element, the filter element will not rotate relative to the upper case half, and the filter element will not wobble and become unstable. Therefore, it is possible to smoothly combine the two case halves, making it very easy to assemble the filter element into the filter case. Also, even if a sealing member is attached around the opening of the filter element, the filter element will not rotate relative to the upper case half while the lower case half is screwed into the upper case half. Therefore, there is no possibility that the sealing member will be damaged due to relative rotation with the pipe portion, or that the sealing function will be deteriorated due to an increase in the inner diameter.

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[Brief Description of the Drawings]

[FIG. 1] A diagram showing both a perspective view of an upper case half of a fuel filter as an embodiment of the present invention seen from below and a perspective view of a filter element seen diagonally from above.

[FIG. 2] A perspective view of the fuel filter seen diagonally from above.

[FIG. 3] A cross-sectional view of the filter device 1 taken along arrows III-III in FIG. 2;

[FIG. 4] (A), (B), and (C) are a side view, a top view, and a bottom view of a single filter element, respectively.

[FIG. 5] A developed view showing a pipe portion provided in the upper case half.

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[FIG. 6] A diagram showing the route followed by the locking protrusion that abuts the side surface of the pleated portion when the filter element is pushed up toward the upper case half.

[FIG. 7] (A), (B), and (C) are bottom views showing filter elements having three types of ring-shaped protrusions that differ depending on the manufacturing lot.

[Explanation of References]

1	Filter device
5	Filter case
7	Element retention space
10	Upper case half
13	Female threads
15	Fuel inflow route
17	Fuel outflow route
18	Pipe portion
19	Pleated portion
19a	Side portion
20	Protrusions
21	Depressions
22	Grooves
30	Lower case half
33	Male threads
36	Filter element mounting part
40	Filter element
41	Inner cylinder
42	Filter media
43	Upper plate

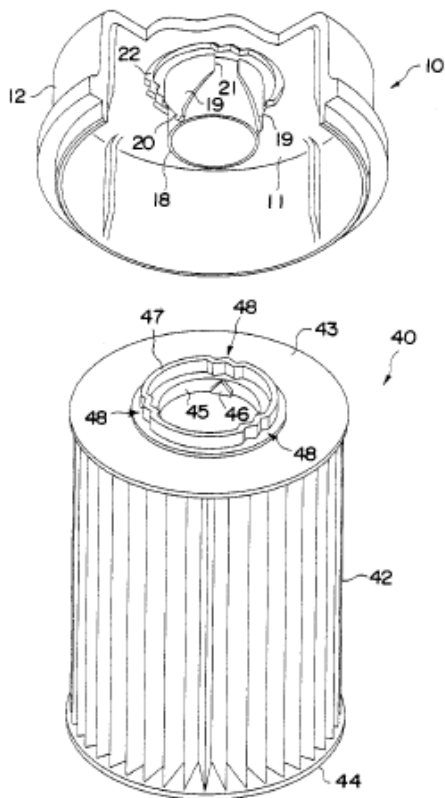
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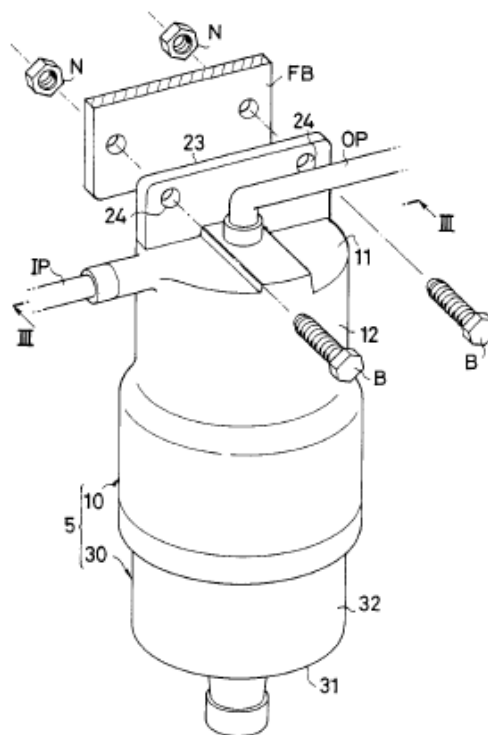
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- 44 Lower plate
- 45 Opening
- 46 Locking protrusions
- 47 Sealing member
- 49 Ring shaped protrusions

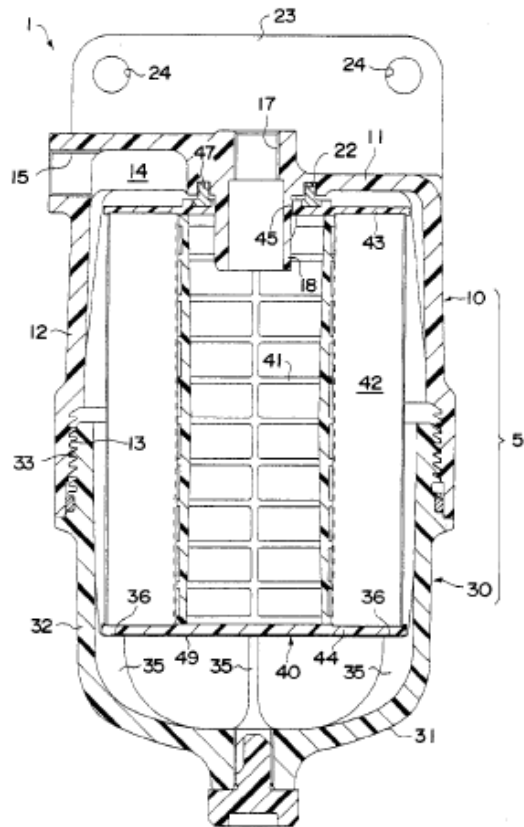
[FIG. 1]



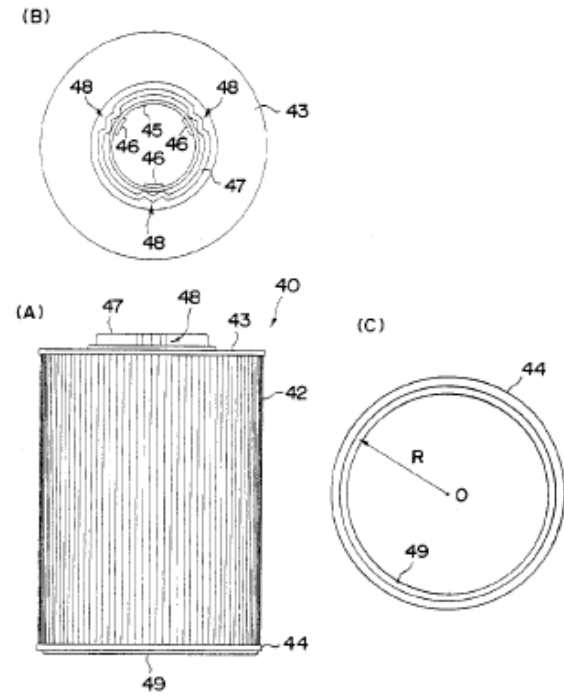
[FIG. 2]



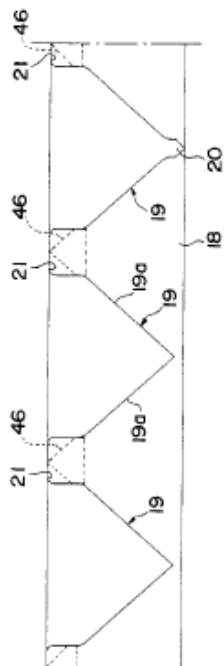
[FIG. 3]



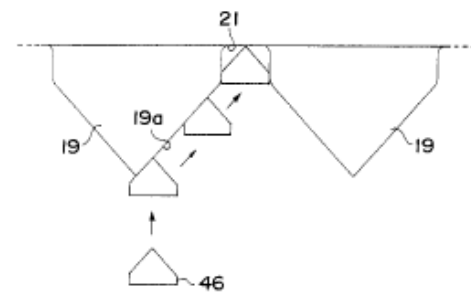
[FIG. 4]



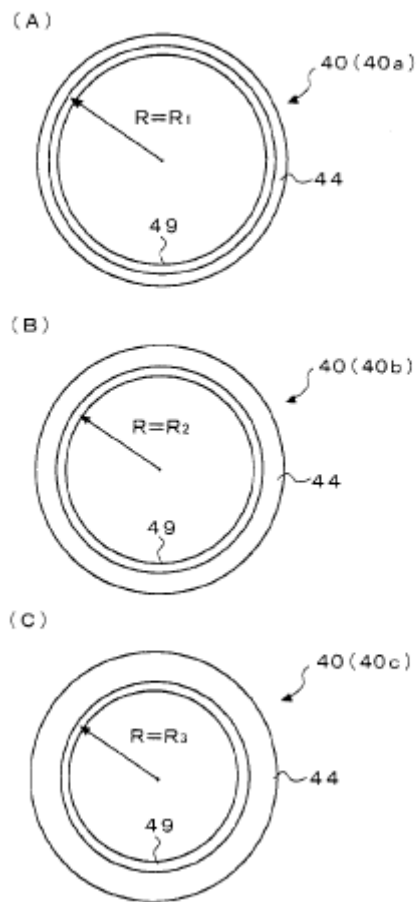
[FIG. 5]



[FIG. 6]



[FIG. 7]



DECLARATION OF GWEN SNORTELAND

I, GWEN SNORTELAND, pursuant to 28 U.S.C. § 1746, hereby declare as follows:

1. I am a freelance translator at TransPerfect, Inc.
2. I submit this declaration to certify the accuracy of the English translation of JP2004136203A
3. My statements are based on personal knowledge and my review of JP2004136203A and its Japanese to English translation. If called as a witness about the facts contained in these statements, I could testify competently based on such personal knowledge and the investigation I have conducted.
4. Attached as Exhibit A is a true and accurate copy of JP2004136203A
5. Attached as Exhibit B is a true and accurate copy of an English translation JP2004136203A.
6. JP2004136203A Translation is a true and accurate translation of JP2004136203A from Japanese to English
7. All statements made herein of my own knowledge are true, and all statements made on information and belief are believed to be true. Further, I am aware that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001. I declare under penalty of perjury that the foregoing is true and correct.
8. I also understand that by submitting this declaration I may be asked to appear for a deposition asking me questions limited to the material in my declaration. With my signature below, I agree to make reasonable efforts to make myself available for such a deposition at a reasonable place and time of my choosing.

* * *

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge. Executed on JANUARY 3, 2024 at CLEVELAND, OHIO.



GWEN SNORTELAND



Signature, Notary Public



WILLIAM H. SNORTELAND
NOTARY PUBLIC, STATE OF OHIO
My Commission Expires Jan. 21, 2027
Notary Public